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Office Rent in the Chicago CBD

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Abstract

OFFICE RENT IN THE CHICAGO CBD

This study focuses on the Chicago CBD office market, an important

market at the local, regional, national, and international levels. The

purpose of this study is to develop a hedonic regression model that

explains the variation in office rent per square foot. Five functional

forms (linear, reciprocal, logarithmic, semi-log, and log-linear) of

the model are considered. A generally log-linear model is determined

to be the best model based on a Box-Cox test. The regression results

reveal that the model has very high explanatory power. The model

developed differs from models developed in previous studies in terms

of the unit of analysis, data requirements, and a number of key explana-

tory variables, especially characteristics of the lease.

INTRODUCTION

There are approximately 80 million square feet of existing office space in Chicago's Central Business District (CBD). An additional 10 million square feet were under construction as of mid-1983 [4]. The Chicago CBD office market is an important market at the local, regional, national, and international levels. Both suppliers and users of office space in this market are primarily interested in the rental rate, holding quality constant. The purpose of this paper is to explain the variation in office rent per square foot in the Chicago CBD. A hedonic price index is utilized for this purpose [5 and 8]. After a review of the literature, a model is developed which differs from models developed in previous studies in terms of the unit of analysis, data requirements, and a number of key explanatory variables, especially characteristics of the lease. The regression results reveal that the model has very high explanatory power.

LITERATURE REVIEW

In the first part of the literature review, the variables included in three econometric studies of office rent are identified. Then the alternative functional forms considered in each of the three studies are discussed. Finally, potential problems with these studies are identified.

Identification of Variables

Variation in rent per square foot among office buildings is influenced by variables associated with each building and its site, including

its relative location. The variables selected by Clapp in his study of the office market in the Los Angeles metropolitan area [3] include: 1) total rentable square feet of floor space in the building, 2) age of the building, 3) number of office floors, 4) whether or not the building has internal parking, 5) whether or not the building has a Beverly Hills address, 6) annual amount of property taxes, 7) smog levels in the immediate area, 8) square feet of office space within a two-block radius, 9) distance by road from the building to the nearest freeway entrance and by freeway to the CBD, and 10) average commuting time for employees from home to the building by auto. While the Beverly Hills variable is unique to the Los Angeles area, other metropolitan areas have prestige addresses also. The smog variable may not be as significant in some other metropolitan areas, but it is certainly not unique to Los Angeles. The commuting variables, 9) and 10), would be much more important for a study of an entire metropolitan area than for a study of just the CBD where these measures would not vary substantially across buildings. Two other variables were considered, but were found to be statistically insignificant. These two variables were the percentage of employees who commute by bus and an internal amenity dummy variable based on observations of lobbies and elevator bays.

In a recent study of the Chicago CBD office market, Hough and Kratz [6] identify the following variables: 1) radial distance from the building to the center of the CBD (assumed by them to be the inter-section of Clark and Madison Streets); 2) proximity to commuter transportation—radial distance to the nearest commuter train station and availability of public parking near the building; 3) measures of

building responsiveness to tenant needs--age of the building, its total gross floor area, and average rental area per floor; 4) building amenities--number of floors, presence of a restaurant, and availability of a conference room; 5) building disamenities--age of the building (assumed to influence rent in at least two ways), whether or not it contains a snack shop, and whether or not the elevated train tracks pass by the building; and 6) measures of architectural quality-- whether or not the building has been designated a national or Chicago landmark (the newest designated building was built in 1930) and whether or not it has received a Chicago American Institute of Architects award for aesthetic architectural excellence (from 1955 to 1978). Several of these variables were found to be statistically insignificant, specifically: radial distance to the nearest commuter train station, total gross floor area, whether or not there is a restaurant present, whether or not there is a snack shop present, and whether or not the building has been designated a national or Chicago landmark. The principal purpose of the Hough and Kratz study is to determine if the value of "good" architecture has been internalized by tenants and/or owners of office buildings. The authors conclude, "that a considerable rent premium is paid for 'good' new architecture but not for 'good' old architecture."

In a study of a smaller urban area, Champaign-Urbana, Illinois, Cannaday and Kang [2] identified the following variables: 1) average number of units per floor; 2) average square feet of leasable space per unit; 3) age of the building; 4) distance to the center of the urban area; 5) distance to the nearest shopping center; and 6) the

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required minimum lease term. All variables except distance to the
nearest shopping center were found to be statistically significant in
their final model.

Alternative Functional Forms

Although two of the three studies experimented with different func-
tional forms, only Hough and Kratz offer a test for the preferred form.
Clapp used a log-linear functional form and his best seven variable
equation explained 66.38 percent of the variation in the log of office
rent per square foot. Hough and Kratz tried four functional forms:
linear, logarithmic (log in characteristics), semi-log (log in rent),
and log-linear. Based on a Box-Cox test they concluded that the linear
and logarithmic models were superior to the other forms. Their final
eight-variable linear model explained 60.9 percent of the variation in
rent per square foot while their final nine-variable logarithmic model
explained 65.8 percent of the variation. The public parking variable
was statistically significant in the logarithmic model, but not in the
linear model. Cannaday and Kang used two functional forms, linear and
log-linear. Their six-variable linear model explained 58 percent of
the variation in rent per square foot while their five-variable log-
linear model explained 85 percent of the variation in rent per square
foot. The reason for the difference in the number of variables in the
two Cannaday and Kang models is that distance to the nearest shopping
center was statistically significant in the linear model, but insigni-
ficant in the log-linear model.

Problems

There are problems with both the construction of the dependent variable and the omission of key independent variables in the previous studies. All three previous studies define the rental rate inappropriately. None of the three focuses on other lease terms as explanators of rent per square foot.

In the Clapp study, the quoted annual rental rate (in 1973-1974 dollars) per square foot of floor space is used as the basis for the dependent variable. Also in the Clapp study, the unit of observation is the office building so an average rental rate for the building is used. In both the Hough and Kratz study and the Cannaday and Kang study, the average current rental rate for the building is used as the dependent variable. The rental rate used is the average rate per square foot in the building for existing leases as of one point in time (regardless of when the leases began).

The use of the building as the unit of observation effectively precludes including the date of the lease transaction for each office unit within the building as an independent variable. Therefore, no variable is used in the previous studies to take into account the fact that transaction rental rates on which the average rate is based may have been negotiated at different points in time when market conditions may have significantly differed.

While it appears to be generally accepted that physical and locational characteristics are important determinants of rental rates for office space, very little has been done with features of the lease contract other than rent. The Cannaday and Kang study is the only one

cited that included a variable related to lease terms, and it concerned a general policy of the landlord (minimum lease term in years) rather than specific features of particular lease contracts. In addition to physical and locational characteristics, certain specific features of the lease contract may have an important influence on the level of rental rates.

This paper avoids the problems outlined above. Office units within a building are used as the unit of observation. Actual transaction rental rates are used as the dependent variable. Finally, several features of the lease contract are included as independent variables.

DEVELOPMENT OF THE MODEL

In this section, the data on office lease transactions in the Chicago CBD are described. Then, the specification of the model is discussed.

The Data

The data for this study is based on a survey of several commercial real estate brokers who are active in the office leasing market for the Chicago Central Business District. They were asked to provide information on actual transactions in which they were involved over the past three years. The sample includes 29 transactions involving leasable areas of 800 to 120,000 square feet and rental rates of $12 to $27 per square foot (see Table 1 for summary statistics). The specific information collected on each transaction is summarized as

TABLE 1

Summary Statistics for Data

Variable	Mean	Std. Deviation	Variance	Minimum	Maximum
RENT/SF	.18966E+02	.37044E+01	.13723E+02	.12000E+02	.27000E+02
SF	.10855E+02	.22449E+02	.50398E+03	.80000E+00	.12000E+03
TERM	.68621E+01	.44777E+01	.20050E+02	.30000E+01	.20000E+02
WRKLTR	.13414E+02	.57567E+01	.33139E+02	0.	.28000E+02
ABTMT	.47931E+01	.56409E+01	.31819E+02	0.	.24000E+02
STOP	.11034E+01	.21987E+01	.48341E+01	0.	.65000E+01
CPI	.44828E+00	.49732E+00	.24732E+00	0.	.10000E+01
VERT	.19379E+02	.92528E+01	.85615E+02	.100000E+01	.38000E+02
INT	.51724E+00	.49970E+00	.24970E+00	0.	.10000E+01
EXT	.68966E-01	.25340E+00	.64209E-01	0.	.10000E+01
TSQFT	.83541E+03	.53812E+03	.28958E+06	.18000E+03	.30000E+04
TFLRS	.37793E+02	.11312E+02	.12796E+03	.15000E+02	.57000E+02
LOSS	.15759E+02	.39797E+01	.15838E+02	.80000E+01	.23000E+02
OCC	.76897E+02	.20570E+02	.42313E+03	.10000E+02	.95000E+02
AGE	.15000E+02	.20361E+02	.41455E+03	0.	.60000E+02
D80	.13793E+00	.34483E+00	.11891E+00	0.	.10000E+01
D81	.20690E+00	.40508E+00	.16409E+00	0.	.10000E+01
D82	.37931E+00	.48522E+00	.23543E+00	0.	.10000E+01
BSYRDM	.79310E+00	.40508E+00	.16409E+00	0.	.10000E+01
TCON/SF	.21753E+02	.14234E+02	.20261E+03	0.	.60000E+02
LASALLED	.19483E+01	.14284E+01	.20404E+01	.500000E+00	.45000E+02
MADISOND	.13966E+01	.99463E+00	.98930E+00	.500000E+00	.35000E+01
WLASALD2	.52672E+01	.67431E+01	.45470E+02	0.	.20250E+02
ELASALD2	.56897E+00	.22456E+01	.50427E+01	0.	.12250E+02
NMADISD2	.16552E+01	.34419E+01	.11847E+02	0.	.12250E+02
SMADISD2	.12845E+01	.21493E+01	.46195E+01	0.	.62500E+01

follows (with additional clarification of some terms requiring lengthy explanations following the summary):

1. Lease features:

    a. Date of lease execution (ranging from October 1980 to May 1983),

    b. Rental rate in dollars per square foot per year,

    c. The term of the lease, in years,

    d. The "workletter" cost in dollars per square foot,

    e. The number of months of rental abatement,

    f. Whether or not the lease includes Consumer Price Index (CPI) escalation,

    g. Whether there is a "stop" or a "base year escalation" associated with the landlord's obligation to bear increases in certain operating expenses,

    h. If there is a "stop," the amount of that "stop" in dollars per square foot per year;

2. The occupancy rate of the building at the time the lease was executed;

3. Physical characteristics of the building:

    a. Total square feet,

    b. Total number of floors,

    c. Age;

4. Physical characteristics of the unit:

    a. Square feet in the transaction,

    b. Loss factor (proportion of area paid for but not usable),

    c. Vertical location in the building,

    d. Whether or not the unit is in a preferential location within the building regarding ready identification of the tenant,

    e. Whether or not there is any identification of the tenant on the exterior of the building;

5. Location of the building, in terms of a north-south and east-west grid (buildings are only located as to the block in which they are found).

Terms of the trade such as workletter, rental abatement, CPI escalation, stop, and base year escalation may need further clarification. The "workletter" is a written commitment by the landlord to make certain improvements in the space to be leased; e.g., construction of interior walls, provision of additional electrical outlets, construction of raised flooring and/or provision of special air conditioning for computer rooms, etc. Rental abatement relates to the number of months that the tenant can occupy the unit before he has to start paying rent. Consumer Price Index (CPI) escalation means that rents are increased as the CPI increases, usually by 20 to 65 percent of the rate of increase in the CPI. Rents are also increased in proportion to increases in operating expenses, either by a "stop" or a "base year escalation." A "stop" sets the amount above which the tenant is obligated to pay his proportionate share of increases in the cost of operating the building. A "base year escalation" is similar to a "stop" except that the amount above which the tenant pays is an amount determined by base year costs, usually costs in the first year of the lease.

Specification of the Model

Specification of the model includes determination of the best functional form for the model and selection of the independent variables to be included in the model. In general terms, the model can be stated as follows:

$$RENT/SF = f(X_1, X_2, \ldots, X_m)$$

where   RENT/SF   = rental rate in dollars per square foot per year,

X_1 = SF   = square feet included in a particular lease transaction

X_2 = STOP   = amount of "stop" in dollars per square foot per year,

X_3 = CPI   = 0 if lease does not include CPI escalation,

                      = 1 if lease includes CPI escalation,

X_4 = VERT   = vertical location of the unit in the building

X_5 = TSQFT   = total square feet in the building,

X_6 = LOSS   = percent of area paid for but not usable; e.g., common areas such as hallways and lobby,

X_7 = BSYRDM   = 0 if there is no "base year escalation" (i.e., there is a "stop"),

                      = 1 if there is a "base year escalation,"

X_8 = LASALLED = distance in blocks from LaSalle Street along the east-west axis,

X_9 = MADISOND = distance in blocks from Madison Street along the north-south axis,

X_{10} = WLASALD2 = 0 for office buildings located east of LaSalle Street,

                      = $LASALLED^2$ for office buildings located west of LaSalle Street,

$X_{11} \ldots X_m$ = any other variable that should be considered (in the interest of brevity, only the variables that are ultimately included in the model are defined above).

Identification of the best functional form of the model is based on specifying alternative models and using the Box-Cox transformation procedure [1 and 7] to identify the model with the highest logarithmic likelihood. Selection of the independent variables to be initially included in the model is based on suggestions in previous studies and the availability of data, while the variables finally included are those which are found to have significant coefficients.

Prior to estimating alternative models, several hypotheses were developed concerning the expected signs of the coefficients in the model. The first set of hypotheses is that the variables STOP, VERT, TSQFT, BSYRDM, and WLASALD2 are directly related to the rent per square foot. For STOP, the rationale is that the higher the amount of the "stop," the less the tenant would have to pay of the increase in operating expenses and therefore the initial rent per square foot would be correspondingly higher, holding other variables constant. For VERT, the rationale is that the higher the location of the unit in the building, the more likely the unit is to have a desirable view; therefore, the higher the rent. For TSQFT, the expectation is that the larger the building, the more prestigious the building and the more linkages and, therefore, the higher the rent. The coefficient of the variable BSYRDM is assumed to have the same sign as the coefficient for the variable STOP. The rationale for this is the same as for STOP. In addition, there should be a "stop" amount that is the equivalent of having a "base year escalation" clause. The variable WLASALD2 is designed to capture any increase in rents that might begin a certain distance to the west of LaSalle Street and continue to the western edge of the CBD.

The second set of hypotheses is that the variables SF, CPI, LOSS, LASALLED, and MADISOND are inversely related to the rent per square foot. For SF, the assumption is that the larger the number of square feet included in an individual lease transaction, the lower the rent per square foot the landlord would be willing to accept and the tenant would be willing to offer, holding other variables constant. For CPI, the rationale is that for leases with a CPI clause the initial rent per

square foot will be lower than for leases without a CPI clause.
Landlords expecting inflation will feel somewhat protected by the CPI
clause and will be willing to charge an initially lower rent, holding
other variables constant. Likewise, tenants expecting inflation will
be willing to pay initially higher rates to exclude the CPI clause.
For the LOSS variable, the assumption is that the higher the loss fac-
tor the lower the rent per square foot since the tenant is getting pro-
portionally less usable space. For the LASALLED and MADISOND variables,
the assumption is that in general rents decrease with distance from
LaSalle and Madison Streets (distance from Clark Street, as an alterna-
tive to LaSalle Street, also was considered, as suggested by Hough and
Kratz).

REGRESSION RESULTS

The regression results for alternative models are presented in
Table 2. The four functional forms (linear, logarithmic, semi-log, and
log-linear) suggested by Hough and Kratz are included. A fifth func-
tional form (reciprocal of rent per sq. ft.) is added because it was
suggested by the Box-Cox transformations.

Additional independent variables initially were included, but were
found to be statistically insignificant in all models or were highly
collinear with other included variables. Some of the variables that re-
main are not statistically significant in every model, but are signifi-
cant in some models and all variables except LOSS are significant at
the 99 percent level in Model 5B (the "best" model). The variable LOSS

TABLE 2

Regression Results[†]
Based on 29 Observations

DEPENDENT VARIABLE	(1) RENT/SF	(2) ln RENT/SF	(3) SF/RENT	(4A) RENT/SF	(4B) RENT/SF	(5A) ln RENT/SF	(5B) ln RENT/SF
SF	-0.0306 (-2.083)*	-0.00147 (-2.168)**	0.000073 (2.133)**	[ln SF] -0.4680 (-1.459)	-0.0322 (-2.806)**	[ln SF] -0.02591 (-1.782)*	-0.00164 (-3.221)**
STOP	2.4896 (3.046)**	0.14573 (3.868)**	-0.008560 (-4.471)**	2.3760 (3.114)**	1.9907 (3.134)**	0.13504 (3.905)**	0.11379 (4.036)**
CPI	3.3767 (4.655)**	0.17202 (5.146)**	-0.008988 (-5.290)**	2.9725 (4.299)**	2.9414 (5.017)**	0.15387 (4.909)**	0.15084 (5.795)**
VERT	0.0732 (2.000)*	0.00397 (2.353)**	-0.000219 (-2.560)**	[ln VERT] 1.1625 (2.654)**	[ln VERT] 1.0404 (2.738)**	[ln VERT] 0.06219 (3.133)**	[ln VERT] 0.05546 (3.288)**
TSQFT	0.0016 (2.429)**	0.00007 (2.434)**	-0.000003 (-2.291)**	[ln TSQFT] 1.9242 (3.850)**	[ln TSQFT] 2.0080 (4.562)**	[ln TSQFT] 0.09879 (4.362)**	[ln TSQFT] 0.10326 (5.284)**
LOSS	-0.1429 (-1.438)	-0.00968 (-2.113)**	0.000643 (2.763)**	[ln LOSS] -1.0326 (-0.780)	[ln LOSS] -1.1553 (-0.990)	[ln LOSS] -0.08159 (-1.359)	[ln LOSS] -0.08690 (-1.677)
BSYRDM	15.0910 (3.362)**	0.89222 (4.313)**	-0.053097 (-5.050)**	14.9040 (3.565)**	12.7270 (3.693)**	0.85228 (4.498)**	0.73179 (4.784)**
LASALLED	-0.7875 (-1.464)	-0.06083 (-2.453)**	0.004594 (3.645)**	[ln LASALLED] -0.9866 (-1.628)	[ln LASALLED] -1.0962 (-2.172)**	[ln LASALLED] -0.06178 (-2.249)**	[ln LASALLED] -0.06876 (-3.069)**
MADISOND	-1.4426 (-3.808)**	-0.07231 (-4.142)**	0.003747 (4.223)**	[ln MADISOND] -1.6657 (-3.925)**	[ln MADISOND] -1.8728 (-4.869)**	[ln MADISOND] -0.08945 (-4.650)**	[ln MADISOND] -0.09973 (-5.841)**
WLASALD2	0.2523 (2.278)**	0.01664 (3.260)**	-0.001127 (-4.344)**	0.1910 (2.542)**	0.2144 (3.334)**	0.01123 (3.297)**	0.01253 (4.391)**
Constant	4.8017 (1.139)	2.14020 (11.016)**	0.098395 (9.965)**	-9.6853 (-1.606)	-7.8378 (-1.480)	1.43840 (5.262)**	1.53680 (6.535)**
$\overline{R}^2$	0.833	0.876	0.896	0.866	0.896	0.903	0.928
Log-Likelihood Function	-46.727	-42.265	-40.638	-43.580	-39.940	-38.634	-34.390

[†]Coefficients are given in the body of the table with T-ratios in parentheses. When the coefficient is for the log of an independent variable, it is so indicated by [ln Variable Name].

*Coefficient is significantly different from zero at 90 percent level of confidence.

**Coefficient is significantly different from zero at 95 percent level of confidence.

is significant at the 95 percent level in Models 2 and 3 and, based on a one-tail test, is significant at the 90 percent level in Models 1, 5A, and 5B. LOSS is retained in the final model since it was expected to have a negative coefficient and hence a one-tail test of significance is appropriate.

Excluded Variables

As indicated, additional variables were excluded because they were found to be insignificant or highly collinear with other included variables. These excluded variables include: 1) dummy variables for date of lease (D80, D81, and D82); 2) length of the lease (TERM); 3) workletter cost (WRKLTR); 4) months of rental abatement (ABTMT); 5) total concessions (TCON/SF) based on combining variables 3) and 4); 6) occupancy rate of the building (OCC); 7) number of floors in the building (TFLRS); 8) age of the building (AGE); 9) dummy variable for whether or not the unit is in a preferential location within the building (INT); 10) dummy variable for whether or not there is any exterior identification of the unit (EXT); and, 11) three variables similar to WLASALD2 that were used to test whether rents were non-monotonic to the east of LaSalle Street or north or south of Madison Street (ELASALD2, NMADISD2, and SMADISD2).

The insignificance of the dummy variables developed to reflect the date of the lease transaction may have a simple explanation. It could be that rents were falling in real terms from 1980 to 1983 at roughly the rates of inflation during those periods.

The length of the lease may not be significant for a couple of reasons. The role of length of lease depends on the expectations of landlords and tenants. If rents are not expected to change by landlords, they would prefer longer to shorter leases so as to reduce transaction and vacancy costs. However, if landlords expect rents to rise somewhat, they may be neutral as to length of the lease. Similarly, tenants have expectations about future rents and a desire to avoid transaction and moving costs while maintaining some locational flexibility. It is possible for these factors to combine to make tenants more or less neutral to length of the lease also. Finally, if a change in length of the lease causes both the tenant's willingness to pay and the supply curve to shift in the same direction, length may be insignificant in a reduced form model such as ours.

Concessions, such as the workletter and rental abatement, would seem to be important at first. However, workletter cost might not be significant if the structural changes were in line with bringing the office space up to some generally expected standard rather than meeting highly specialized needs of particular tenants. Also, rental abatement might be insignificant if it is correlated with some excluded variable such as some dimension(s) of quality. Finally, it is not surprising that the total concessions variable is insignificant since the individual concesssions are not significant.

It is peculiar that neither occupancy rate, age, nor exposure proved to be significant. The occupancy rate might be insignificant because it is correlated with some excluded variable. The age of the building might be insignificant if the office space in the market is

regularly brought up to contemporary standards via workletters or other mechanisms. The internal exposure variable might be insignificant because certain tenants (perhaps law firms and others concerned with security) may prefer the less exposed office locations within the buildings. This would offset the effect of other tenants preferring the more exposed positions. The same might be said for the exterior identification variable.

Modeling location was difficult but ultimately proved rather fruitful in explaining rent. Initially, radial distance from the intersection of Clark and Madison Streets, as suggested by Hough and Kratz, was tried but did not work very well. Based on several trials it was found that LaSalle Street worked better than Clark Street and that using two distances, distance from the north-south street and distance from the east-west street, worked better than simply using radial distance. Finally, four variables were created to test whether rents were non-monotonic in any direction from LaSalle and Madison Streets. Only the variable for west of LaSalle Street (WLASALD2) was found to be significant. Based on Model 5B, a contour map and a three-dimensional view of the estimated locational variation in rent per square foot are presented in Figures 1 and 2, respectively. In Figure 1, it can be seen how the iso-rent contours become distended along LaSalle and Madison Streets by using two distances rather than simple radial distance from the intersection. The three-dimensional view of the rent surface shown in Figure 2 illustrates how the variable WLASALD2 captures the non-monotonic nature of the rent surface west of LaSalle Street. Since the closest distance is one-half block, the extreme peaks shown in

FIGURE 1

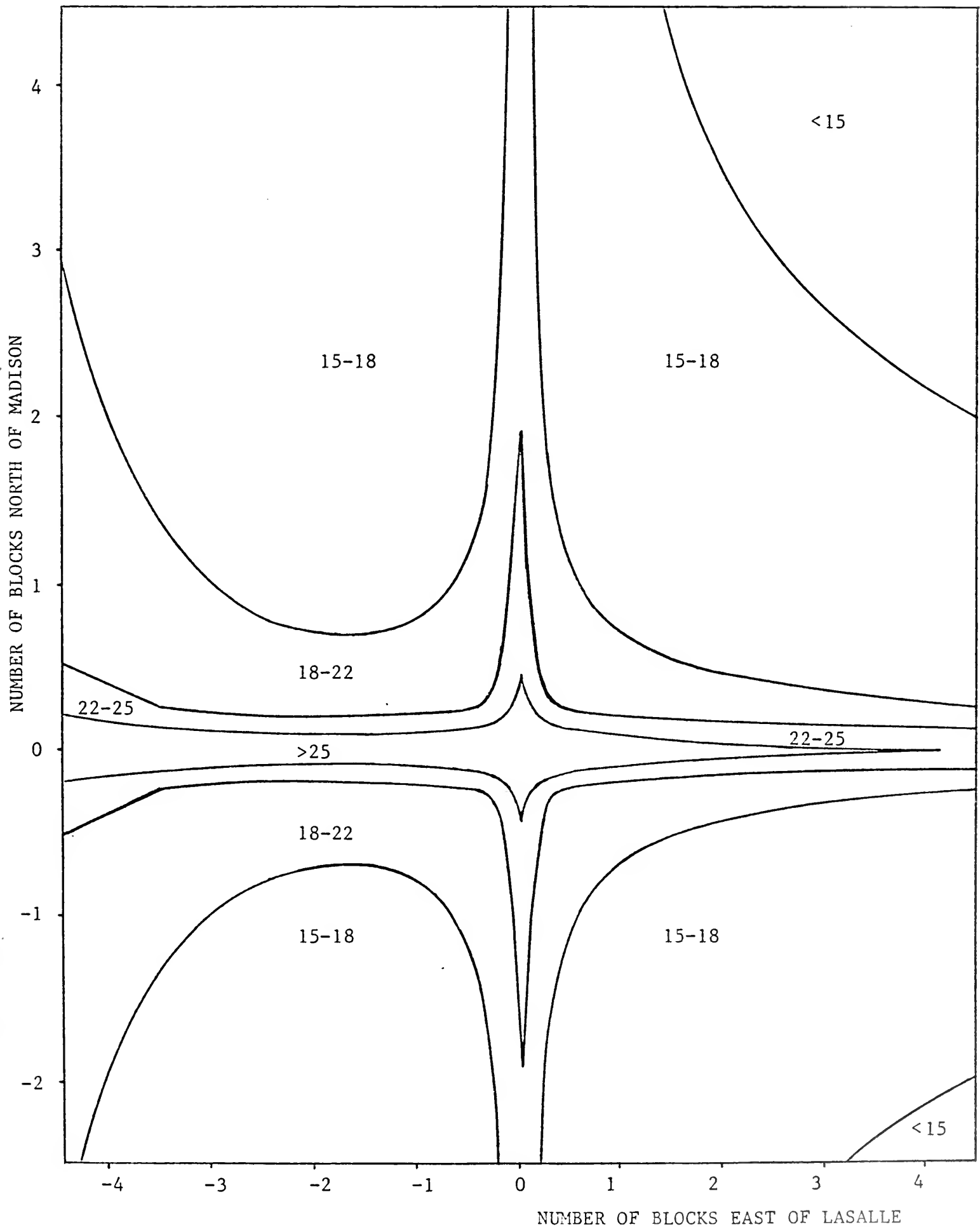## ISO-RENT CONTOURS IN THE CHICAGO CBD
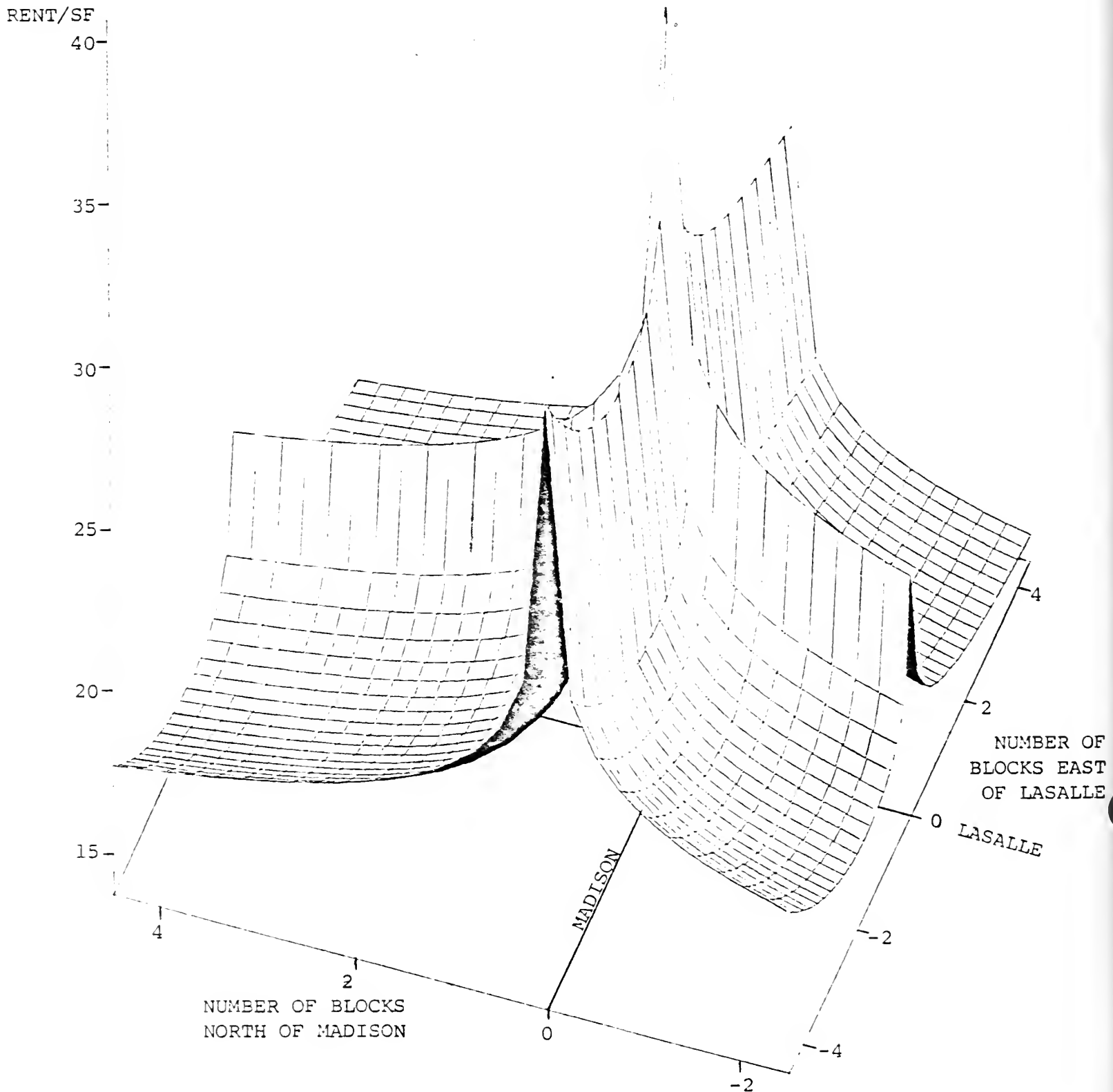
FIGURE 2

RENT SURFACE IN THE CHICAGO CBD

Figure 2 along LaSalle and Madison Streets must be considered simply an artifact of the methodology rather than illustrative of relative rents along these streets.

The total number of floors in the building is omitted for an entirely different reason than the other variables listed above. Total floors is somewhat correlated with the total square feet in the building and highly correlated with vertical location of the unit in the building, both of which are included in the model. The included variables produce much higher explanatory power than any combination with total floors included.

Choice of Best Model

Choice of the best model cannot be based on $\overline{R}^2$ since the dependent variable is not the same for all models. In order to choose between alternative models, the method of maximum likelihood is used. Since it has a significantly higher logarithmic likelihood, it is concluded that Model 5B fits the data better than any other model considered. The test for significance is based on the theory that under the null hypothesis twice the difference in the logarithmic likelihood between a null and alternative hypothesis is distributed as χ^2 with the number of degrees of freedom equal to the difference in the number of unrestricted parameters. This and subsequent significance tests are based on the 90 percent level of confidence.

Alternative models are discussed in more detail in the order they are presented in Table 2. Model 1, the linear model, results in an $\overline{R}^2$ of 0.833 and a logarithmic likelihood of -46.727. Model 2, the semi-log

model, can be considered better than Model 1 on the basis of its significantly higher logarithmic likelihood. On the basis of a Box-Cox transformation of the dependent variable only (constraining λ for the independent variables to be one), it was found that the maximum logarithmic likelihood occurred at $\lambda = -0.926$. Since the logarithmic likelihood for $\lambda = -0.926$ is not significantly different from that for $\lambda = -1$, it seemed appropriate to add a fifth functional form with the reciprocal of RENT/SF as the dependent variable (this is Model 3). The logarithmic likelihood for Model 3 is significantly higher than that for Models 1 and 2.

Models 4A and 4B are both logarithmic in the relevant independent variables, differing only with regard to the treatment of the variable SF. Model 4A was intended to be a model incorporating the log of each independent variable. However, four variables (STOP, CPI, BSYRDM, and WLASALD2) have some observations with zero values and could not be transformed into log form. Also, it was decided to test each of the other variables to determine whether the model could be improved if some of these other variables were not transformed to logs. The result was Model 4B in which the variable SF is not transformed. The logarithmic likelihood for Model 4B is significantly higher than that for Model 4A or for Models 1 and 2. On the basis of a Box-Cox transformation of selected independent variables (constraining λ to be one for the dependent variable and for SF, STOP, CPI, BSYRDM, and WLASALD2 and constraining the λ's for the remaining variables to be equal), it was found that the maximum logarithmic likelihood occurred at $\lambda = -0.094$ and is not significantly different from that for $\lambda = 0$.

Models 5A and 5B are both log-linear for the most part, differing only with regard to the treatment of the variable SF. Model 5A was intended to be a log-linear model, but like Model 4A not all the independent variables could be transformed to logs. Again, it was found that Model 5A could be improved if the variable SF was not transformed. This resulted in Model 5B, a model with relatively high explanatory power; i.e., it has an $\overline{R}^2$ of 0.928. Also, the logarithmic likelihood for Model 5B is significantly higher than that for Model 5A or any other of the models considered. On the basis of a Box-Cox transformation of the dependent variable and selected independent variables (constraining λ to be one for SF, STOP, CPI, BSYRDM, and WLASALD2 and constraining the λ's for the remaining variables to be equal), it was found that the maximum logarithmic likelihood occurred at $\lambda = 0.172$ and is not significantly different from that for $\lambda = 0$.

Signs of Coefficients

Reference Table 2, it can be seen that most of the signs for coefficients of independent variables turned out as hypothesized. The coefficients of the variables STOP, VERT, TSQFT, BSYRDM, and WLASALD2 are positive, as expected. Also, as expected, the coefficients of the variables SF, LOSS, LASALLED and MADISOND are negative. However, the coefficient of the variable CPI is positive instead of negative as hypothesized. One possible explanation is that landlords with the most desirable properties are able to require a CPI clause, and that the variable CPI is acting as a proxy for some of the characteristics of the property that influence its desirability but are omitted from the

model. However, none of the other variables for which we had data were significant and even when they were included in the model, the coefficient of CPI was consistently positive. Therefore, if this is an omitted variable problem it must be related to variables for which we do not have data.

CONCLUSIONS

One of the key variables in an investment analysis for rental property such as office space is the rental rate. This study develops a hedonic regression model that explains the variation in rent per square foot in the Chicago CBD. In contrast to previous studies, rental rates are based on actual transactions and the office unit within a building is used as the unit of observation. In addition, several variables related to provisions of the lease are found to be statistically significant. Finally, a more highly developed set of location variables is utilized. Thus, several improvements over previous models are incorporated in the model developed here.

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